

## REMARKS

### Amendments to Claims

Claim 1, the only independent claim, has been amended to recite important features of the claimed compact high-efficiency separation column, including that at least one secondary gas outlet is arranged annularly around a primary gas outlet as disclosed in paragraph [0041] of Applicant's published application, and that the means for removing and guiding liquid-enriched fluid entirely surrounds the uppermost end of each conduit of each primary separation device, and is arranged to admit all liquid-enriched fluid downwardly into the free inner space along a curved trajectory at a velocity such that the entrained liquid in the liquid-enriched fluid is separated from the secondary gas to about the same low liquid content as the primary gas. Support for these amendments is found in paragraphs [0019], [0020] and [0021] of Applicant's published application. Another limitation now recited in amended claim 1 is that all of the secondary gas outlet openings, including the secondary gas outlet opening(s) that is/are arranged annularly around a primary gas outlet, are located above the means for removing and guiding liquid-enriched fluid, as shown in Figs. 1 and 2.

Dependent claim 14 has been amended to change its dependency to claim 7, and to recite that the secondary gas outlet that is arranged annularly around the primary gas outlet conduit, is located above the means for removing and guiding the liquid-enriched fluid as shown in Figs. 1 and 2 of Applicant's published application.

Claims 16 -18 which claim a process for separating natural gas from condensate or water have been amended to recite specific manipulative steps. Support for the amendments is found in paragraphs [0019], [0020], [0021] and [0056] of Applicant's published application.

### Claim Rejections - 35 U.S.C. § 103

**The rejection of claims 1, 3-8 and 15-18 under 35 U.S.C. 103 (a) as being unpatentable over DE 38 32 420 (Artemov) taken together with EP 0 048 508 (Schuurmans), is respectfully traversed.**

### **DE 38 32 420 (Artemov et al) (hereafter "Artemov")**

Artemov concerns a centrifugal steam separator for separating liquid water out of wet steam from a from the high pressure section of a turbine to produce dry stream for use in the low

pressure section of the turbine. While some of the parts of the centrifugal steam separator disclosed in Artemov are similar to parts of the separation trays employed in Applicant's compact high-efficiency separation column, there are a number of important distinctions between the centrifugal steam separator of Artemov and the compact high-efficiency separation column recited in the claims as presently amended.

As acknowledged in the subject Office action, Artemov does not teach use of a plurality of vertically spaced apart separation trays in a compact high-efficiency separation column, does not teach the bottom of the return skirt (the means for removing and guiding liquid-enriched fluid) being within 30% of the spacing between the upper and lower walls, counted from the lower wall, does not teach at least one opening in the wall of the tubular conduit of the primary separation device, and does not teach the return skirt being integrally formed with the upper wall.

In addition, Artemov does not teach three new limitations added to amended claim 1. The newly added limitations are that the means for removing and guiding liquid-enriched fluid surround the uppermost end of each conduit of each primary separation device, that at least one of the plurality the secondary gas outlet openings is arranged annularly around a primary gas outlet, and that means for removing and guiding the liquid-enriched fluid be arranged so that the liquid-enriched fluid flow along a curved trajectory at a velocity such that the entrained liquid is separated from the secondary gas to about the same low liquid level as the primary gas.

In the following section applicant will comment on some of the limitations the Examiner acknowledges are not taught by Artemov as well as the new limitations.

Regarding the limitation that the return skirt be within 30% of the spacing between the upper and lower walls, it is pointed out that while the bottom end of the cap 14 in Fig. 1 of Artemov appears to be located about 3/8 or 37.5 % of the spacing between upper tube floor 7 and lower tube floor 6 as noted in the Office action, there is no indication that the apparatus in Fig. 1 is to drawn to scale, nor is there any specific teaching by Artemov that the location of the bottom end of cap 14 is important.

Applicant has found the spacing and location of the means for removing and guiding liquid-enriched gas, the arrangement of these means so that the liquid-enriched fluid enters the inner space at a low velocity producing a curved trajectory are all important to achieving separation of the entrained liquid in the secondary gas to about the same low liquid level as the primary gas. This combination of limitations is not taught by or reasonably suggested by Artemov. To the contrary, the Examiner's attention is drawn to last paragraph on page 3 of the

translation of the Artemov specification where it is taught that “water, entering via annular gap 10 into the separation chamber 3, drips from the separating wall or the caps 14 onto the tube floor 6 and continues to flow through the short pipe 5 out of the centrifugal separator.” (emphasis added). This certainly doesn’t suggest the importance to liquid-enriched fluid having a curved trajectory in order to effect separation of the entrained liquid in the inner space.

Regarding the newly added limitation that the means for removing and guiding liquid-enriched fluid surround the uppermost end of each conduit of each primary separation device, this of course is not possible in centrifugal steam separator of Artemov, since the uppermost end of the primary separation device in Artemov is the upper end of separating tube 9, which separating tube is necessary to restore linear flow to the dry steam. In the presently claimed invention the uppermost end of each conduit of the each primary separation device, i.e., swirl tubes 25a, 25 b and 25c in Fig.1, is surrounded by the means for removing and guiding the liquid-enriched fluid, i.e., return skirts 45a, 45b and 45c.

#### **EP 0 048 508 Schuurmans et al (hereafter “Schuurmans”)**

On page 4 of the subject Office action it is stated that EP 0 048 508 (Schuurmans) discloses a separation column having a plurality of vertically spaced apart separation trays, the trays including a plurality of primary separation devices each having a tubular conduit, wherein at least one opening (67) is formed in the sidewall thereof. Applicant agrees with this description of the disclosure, but disagrees with the conclusion stated on page 4 of the subject Office action, that it would be obvious to modify the apparatus taught by DE 38 32 420 (Artemov) to have multiple trays vertically spaced apart within a column, with separation devices on the trays to include at least one opening in the sidewall of the tubular conduit in order to reduce the pressure drop in the primary separation device by allowing more exit areas for the liquid enriched fluid from the tubular conduit.

The centrifugal steam separator in Artemov has a separate swirl means 12 and separating tube 9 which are required in order to restore linear flow to the dry steam. Tube 9 extends well above the primary separating tube 8. Because of this significant structural difference between the steam separator in Artemov and the separation apparatus in Schuurmans, it would not be obvious to modify the centrifugal steam separator in Artemov to have multiple trays, and in any event, such modification would not result in a compact high efficiency separation column as required by the present claims.

Moreover, it would not be obvious from the disclosure of an opening in the tubular conduit in Schuurmans, to put similar openings in the tubular conduit 8 of Artemov, because Artemov very clearly teaches that the water separated by centrifugal forces “settles on the inside of tubes 8 and is separated and is carried away via the gap 10 with a portion of the steam into the separation chamber 3”. Thus, if an artisan at the time of the invention wanted to reduce the pressure drop in the primary separation device in Artemov, he or she would simply increase the size of “gap 10”. They would not be motivated to place openings in the sidewalls 8 since this would interfere with the settling of water on the inside of the tubes 8, which Artemov teaches is desirable in achieving separation of the water from steam.

It is further stated on page 4 of the subject Office action that Schuurmans “also teaches forming the return skirt (72) around the tubular conduit as being integral with the upper wall of the separation tray, and the primary gas outlet tube (68) being formed without any means to restore linear flow to the primary gas downstream of the swirl-imparting means.

Applicant strongly disagrees with the characterization of skirts (72) in Schuurmans as “return” skirts. The Examiner’s attention is directed to the sentence bridging pages 9 and 10 of Schuurmans where the function of skirt 72 is described. It is disclosed that: “In order to prevent that liquid discharged from a separation chamber 63 will hamper the liquid discharge from an adjacent separating chamber 63, skirts 72 are arranged between adjacent chambers 63”. Thus, skirts 72 function to prevent liquid from splashing on adjacent separation chambers. They are not “return” skirts for directing the flow of liquid-enriched secondary gas downwardly into the inner space between the swirl tubes (apparatus 61). In fact, many of swirl tubes 61 and separation chambers 63 in Fig. 7 of Schuurmans do not have skirts on all sides. See Fig.7 and in particular the swirl tubes closest to column wall 62. Since Schuurmans does not teach return skirts, it cannot be obvious from Schuurmans to modify Artemov to form return skirts integrally with the upper wall.

It is also noted that claim 1, as presently amended, contains the limitation that the means for removing and guiding liquid-enriched fluid entirely surround the uppermost end of each conduit of each primary separation device and is arranged to admit all liquid-enriched fluid downwardly into the free inner space. Clearly skirts (72) don’t entirely surround the uppermost end of each conduit of each primary separation device and do not admit all liquid-enriched fluid downward into the inner space. Hence, Schuurmans does not teach or reasonably suggest these limitations.

Nor does Schuurmans suggest modifying the centrifugal steam separator taught in Artemov by forming the return skirt (cap 14 in Artemov) integrally with upper wall (tube floor 7 in Artemov). In order to move cap 14 up to upper tube floor 7 one would have to eliminate separating tube 9 and blades 12, which Artemov teaches are needed to change the rotational movement of the steam to linear flow, which is a desired feature of the centrifugal steam separator in Artemov.

The teachings of Artemov and Schuurmans do not support the position stated in the sentence bridging pages 4 and 5 of the subject Office action, that “It would have also been obvious for an artisan at the time of the invention, to modify the separation devices of the primary reference to eliminate the primary gas straightening means from the primary gas outlet conduit, in view of EP 0 0480 508, since such would also reduce the pressure drop across the trays.”

This position is not supported by Artemov who is trying to provide a centrifugal separator in which uniform pressure reduction in the separation chamber is guaranteed. See last sentence of page 1 of the translation of the Artemov specification. Artemov accomplishes uniform pressure reduction by adding an additional opening to the tube floor between the separation chamber and the dry steam chamber. See paragraph 3 of page 2 of the translation of the Artemov specification. Thus, Artemov teaches uniform pressure reduction is desirable, while Schuurmans is silent on this point. If the skilled artisan wanted to reduce the pressure drop across the trays, the obvious way to achieve this would be to increase the size of opening 13 in tube floor 7 of Artemov, instead of eliminating tubes 9 and blades 12, which are needed to change the rotational motion of the steam to linear flow. See last paragraph of page 2 of English translation of Artemov specification.

**The rejection of claims 9-13 under 35 U.S.C. 103 (a) as being unpatentable over the reference combination as applied to claims 1, 3-8, and 15-18, and further in view of Sheinman, is respectfully traversed.**

**US 5,626,799 Sheinman (hereafter “Sheinman”)**

Sheinman relates to equipment used in heat-mass exchange systems for contacting gas and liquids rather than separating gas and liquid, which is the purpose of the apparatus in Artemov and Schuurmans. Apparently Sheinman is being cited for its teaching that a swirl imparting structure can be formed integrally with a bottom plate of a separator by way of a

stamping process. Applicant does not necessarily agree that “stamping process” inherently performs a slitting step immediately followed by a bending step to provide a swirl vane structure as stated on page 6 of the subject Office action. However, Applicant is not relying for the manner of manufacturing the swirl imparting means for the patentability of claims 9-12, or the arrangement of separation devices in claim 13 for patentability of claim 13. Claims 9-13, which are indirectly dependent on claim 1, are believed to be patentable for the same reasons as discussed above in connection with amended claim 1.

More specifically, the combination of the cited combination of references does not teach or reasonably suggest a compact high-efficiency separation column containing a plurality of vertically spaced apart separation trays, comprising *inter alia* a plurality of secondary gas outlet openings in the upper wall located above the means for removing and guiding liquid-enriched fluid, wherein at least one of which secondary gas outlet openings is arranged annularly around a primary gas outlet, and wherein the means for removing and guiding liquid-enriched fluid entirely surrounds the uppermost end of each conduit of each primary separation device and is arranged to admit all liquid-enriched fluid downwardly into the free inner space along a curved trajectory at a velocity such that the entrained liquid in the liquid-enriched fluid is separated from the secondary gas to about the same low liquid content as the primary gas.

**The rejection of claim 14 under 35 U.S.C. 103 (a) as being unpatentable over the reference combination as applied to claims 1, 3-8, and 15-18, and further in view of EP 0 331 247, is respectfully traversed.**

**EP 0 331 247 (Konijn) (hereafter “Konijn”)**

Konijn discloses a gas/liquid contacting apparatus which comprises a cyclonic separator (13) for separating the gas and liquid after they are contacted in vertical swirl tube (17). The gas leaves the gas/liquid contacting apparatus through a coaxial gas outlet tube (21) which includes an annular gas outlet (33). The annular gas outlet (33) is located below deflector (32), which deflects liquid which is entrained with the gas flowing through passage 27 into annular space 25 and through gas outlet (33). *See* col.3, line 66 to col. 4, line 4. The gas flowing through annular gas outlet 33 is deflected outward radially by the deflector (32) into space outside of outer tube (23) and eventually leaves the apparatus via gas outlet (9).

Claim 14, as now amended, requires not only that at least one of the plurality of secondary gas outlets be arranged annularly around the primary gas outlet conduit, but also that

the secondary gas outlet be located above the return skirt, which is the means for removing and guiding liquid-enriched fluid specified in claim 7 from which claim 14 depends. (Amended claim 1 requires that all of the secondary gas outlet openings, which includes the at least one annular secondary gas outlet, be located above the means for removing and guiding the liquid-enriched fluid downwardly into the inner space.

As discussed above, the annular gas outlet 33 in Konijn is located below the guiding means in Konijn (annular deflector 32), which deflects the gas containing entrained liquid outward radially into the inner space instead of downwardly as required by the present claims. The difference between the apparatus in Konijn and the presently claimed apparatus is further evident from the fact that the gas leaving through annular gas outlet in Konijn contains entrained liquid which is at least partially removed by deflector 32. In contrast, the secondary gas leaving through the annular secondary gas outlet in present apparatus contains very low levels of entrained liquid about the same level of liquid as the gas leaving the primary separation device. Since the gas passing through annular gas outlet 33 in Konijn contains entrained liquid, it would not be obvious to modify Konijn by moving the deflector below the annular outlet, since the deflector is needed to remove entrained liquid from the gas. This is not the case with the secondary gas produced by the present apparatus.

Therefore, claim 14 and claim 1, as amended, are believed to be patentable over Konijn in combination with Artemov and Schuurmans.

### *Claim Rejections – 35 USC § 112*

**The rejection of claims 16-18 under 35 U.S.C. § 112, second paragraph, to the extent it applies to the amended claims, is respectfully traversed.**

Claims 16-18 have been amended to recite specific manipulative steps in the claimed process for separating natural gas from condensates or from water at high pressures using the compact high-efficiency separation column recited in amended claim 1. The manipulative steps include the step of recovering from the inner space natural gas having about the same low condensate level as the natural gas from the primary separation devices. This step is clearly not taught or reasonably suggested by any of the cited references.

In view of the amendments, process claims 16-18 are believed to be in compliance with 35 U.S.C. § 112, second paragraph, and to be patentable over the prior art.

**Conclusion**

For all of the above reasons and in view of the amendments, claims 1 and 3-18 in their present form, are believed to be patentable over the prior art. Accordingly, reconsideration and early allowance of the application is respectfully requested.

Respectfully submitted,

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